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THE MUSCLES OF THE HEAD STOMODEUM OF AN ODONATE NYMPH, ISCHNURA VERTICALIS.

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The fact that the swallowing muscles have not yet been described for any member of the order Odonata was first brought to the writer's attention in the course of studies on the mechanism of moulting and hatching of *I. verticalis*.* A previous writer on that subject had described an Odonate nymph as swallowing water without the use of any stomodeal dilator muscles, which he had assumed were absent.

There are however several papers dealing with the head muscles of other insects of the "Orthopteroid" or "biting and chewing" type, which are sufficiently homologous with Odonata to serve as a basis of comparison in the present case.**

The examination of these muscles in *I. verticalis* was carried out by means of serial sections. *** These comprise several series in three different planes, namely sagittal, frontal, and transverse, in thicknesses ranging from 8 to 25 microns, and with a preference of those of 15 microns. Most of the slides were stained with hematoxalin, and a few with Mallory's triple stain. The latter is admirable for work of this kind, as it differentiates between muscles, nerves, glands, and integument.

Neither the study of the muscles, nor their illustration, by means of sectioned material is as simple as it would be by means of dissections, but the lack of suitable apparatus for micro-dissection precluded the use of that method. It is hoped that the reader with patience to study the diagrams will find the results reasonably exact.

In the matter of nomenclature of the suspensorial muscles, and of the parts of the cranium on which they originate, it has seemed advisable to conform as nearly as possible to the definitions and terminology set up by Snodgrass, (1928 and 1935).

The regions of the stomodeum, as hitherto rather loosely defined by Tillyard, (p. 101-3), and other Odonatologists, have been interpreted by the writer as follows:—buccal cavity and pharynx, undivided, and comprising the heavily muscled area directly back of the oral aperture; esophagus, the narrow, longitudinally folded tube, commencing anterior to the brain, and continuing through the head and thorax.

Snodgrass (1935, p. 285 and 351-2) bases his definitions of these regions, as well as the regions of the cranium, on the relative positions of the dorsal dilator muscles and the lateral connectives of the frontal ganglion. He has also in-

*George, E. G.

**Snodgrass, R. E. (1928 and 1935); Walker, E. M. (1931).

***Most of the sectioned material for this study was prepared while the writer was a student at Cornell University, and acknowledgement is due Dr. J. G. Needham for advice and encouragement. The writer is also indebted to Dr. H. B. Fantham of McGill University for facilitating the preparation of some additional slides.

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troduced a new term for the posterior part of the preoral cavity, the cibarium, (p. 282) which is here indicated in figs. A. and C. The most heavily muscled area becomes the buccal cavity, because its dorsal dilator muscles are anterior to the connectives, as shown in figs. A. H. and O. He considers the pharynx to be the region the dorsal dilator muscles of which are posterior to the connectives, and usually it is pre-cerebral, but in certain "orthopteroid" insects he considers part of the post-cerebral stomodeum as posterior pharynx.

It would seem that, though their status has been improved, the boundaries of these regions are necessarily somewhat arbitrary still, as the reasons for attributing fundamental importance to the position of the frontal ganglion connectives do not appear entirely clear, (to this writer, at least). But the criterion of the frontal ganglion is very convenient, and has been employed in the present case in determining cranial as well as stomodeal homologies.

In *I. verticalis* the anterior, or pre-cerebral, pharynx is very short, hence the number of the pharyngeal dilators is reduced, and the position and direction of some of them are slightly different from those to which they appear to be homologous in other insects. The post-cerebral dilator muscles resemble those of other "orthopteroids," so the section of the tube on which they are inserted is considered posterior pharynx. The transition from posterior pharynx to esophagus is obscure.

THE STOMODEAL MUSCULARIS

The muscular sheath is quite important, and considerably modified, in *I. verticalis*. The head stomodeum is thrown into four longitudinal, double folds, serving as regions of attachment for the dilator muscles, and for the muscularis. The inner sheath of longitudinal muscle fibres is represented here by a pair of dorsal bundles, labelled LM in figs. A and M, extending from the cibarium to the anterior pharynx, and attached to the intima of the stomodeum, anteriorly in the cibarium, (with occasional attachments in the anterior part of the buccal cavity), and posteriorly just within the circle of the circum-esophagal connectives of the brain.

Between the ventro-lateral folds, in the region of the anterior pharynx, are found a few strands of diagonal muscles, which being inside the circular sheath, are presumably derived from the longitudinal muscularis. These are shown in fig. N, labelled DM, and seem to extend only from one ventral fold to the other.

The heavy circular sheath, in the region of the buccal cavity, is really only semi-circular, as shown in fig. M, labelled CM. It consists of a series of strong bands attached at each side to the ventral folds, and passing between the insertions of the dilator muscles. Some strands also appear to pass from one ventral fold to the opposite dorsal fold, — illustrated in figs. L and N. In the pharyngeal region, the circular muscularis is less heavily developed, and extends right around the tube, (figs. J and K) with possibly occasional attachments to the longitudinal folds. All the circular muscles act as constrictors of the stomodeum, presumably functioning in peristalsis.

THE DILATOR MUSCLES

The dilator muscles comprise eight paired sets of muscle fibres and one median unpaired muscle, arising on the skeletal parts of the head, and inserted on the stomodeum, in addition to one unpaired, and three paired muscles inserted on the pre-oral epipharyngeal surface of the labrum and clypeus. Their functions can only be inferred here, as they were not studied in operation.

Compressors of the Labrum.—No. 1 in figs. A, B, C, E, and F. A group of fibres within the labrum, attached to its anterior and posterior surfaces (compressores labrii, of Snodgrass, 1935).

Anterior or Dorsal Retractors of the Labrum.—No. 2 in figs. A, E, F, G, L, M, N, and O. A pair of contiguous muscles consisting of two median bundles of parallel fibres, arising on the frons, just in front of the median ocellus (M.O.) and inserted medially on the base of the dorsal wall of the labrum (=anterior retractors, of Snodgrass, 1928, and levators of the labrum, of Walker, 1931).

Posterior or Ventral Retractors of the Labrum.—No. 3 in fig. D. A. shorter pair of muscles, composed of stout bundles of parallel fibres, arising on the fronto-parietal region, considerably lateral, and slightly posterior to the origin of No. 2. Inserted laterally and ventrally, at the base of the labrum on the epipharyngeal processes of the tormae, as shown in fig. G (=posterior retractors, of Snodgrass, 1928, and depressors of labrum, of Walker, 1931).

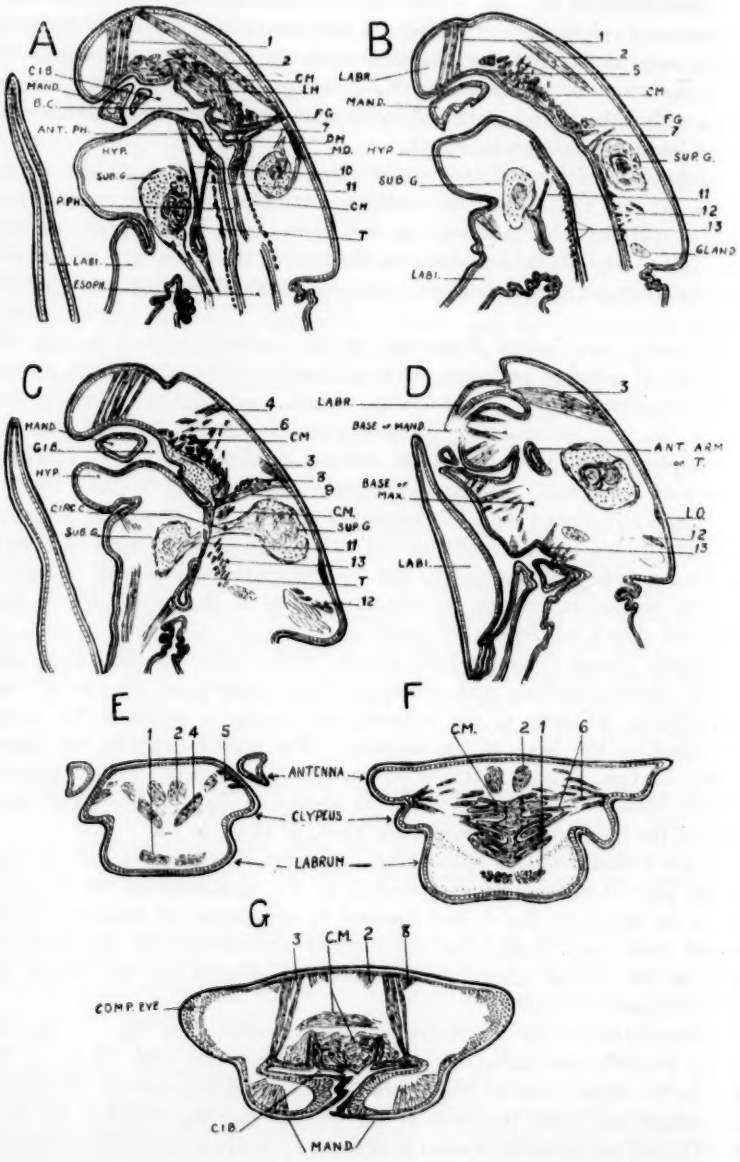
Dorsal Dilators of the Cibarium.—No. 4 in fig. C. A pair of flat muscles with parallel fibres, arising on the dorsal wall of the clypeus, about half way between the antennae and the median line, on the epipharyngeal wall of the cibarium. The postion in relation to other structures is shown in figs. L and M (=dilatores cibarii, of Snodgrass 1935).

Second Dorsal Dilators of the Buccal Cavity.—No. 6 in figs. F, C, and M. A pair of oblique muscles with divergent fibres, arising on the parietal border of the clypeus, adjacent to the antenna, and having a width at the point of origin, equal to the base of the antenna. The muscles spread out fan-wise, as shown in figs. C and F, to be inserted in six or seven paired strands on the dorsal folds of the buccal cavity, as shown in fig. M (=second anterior dilators of the buccal cavity, Snodgrass, 1928, p. 116).

First Dorsal Dilators of the Buccal Cavity.—No. 5 in figs. B, E, and M. A similar pair of oblique muscles, median to No. 6, arising on the clypeus, adjacent to the origin of No. 6, and inserted by six groups of strands (which are separated from one another by the circular muscularis) in the dorso-lateral troughs of the buccal cavity (=first anterior dilators of the buccal cavity, Snodgrass, 1928, p. 116).

Dorsal Dilators of the Anterior Pharynx.—No. 7 in figs. A, and B. A pair, (or possibly two pairs) of slender stalked muscles with divergent fibres, arising on the frons, between the origin of No. 2 and the median ocellus.* The fibres spread out below the level of the frontal ganglion, labelled FG in figs. A, and H, and are inserted in several separate strands on the double forks of the dorsal folds. Some other insects have two pairs of dorsal dilators of the pharynx, the anterior pair arising on the frons, and the posterior pair on the

*The ocelli are only apparent during the latter part of the ultimate instar.



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fronto-parietal area; their insertions considerably separated. But the shortness of the anterior pharynx in *I. verticalis* would bring these insertions close together. Fig. O shows a cross section of No. 7, with a suggestion of the double nature of the muscle. It seems not unlikely that these "Dorsal dilators of the Anterior Pharynx" are homologous with the "Dilatores pharyngis frontalis" plus the "Dilatores pharyngis postfrontalis," Snodgrass, 1935.

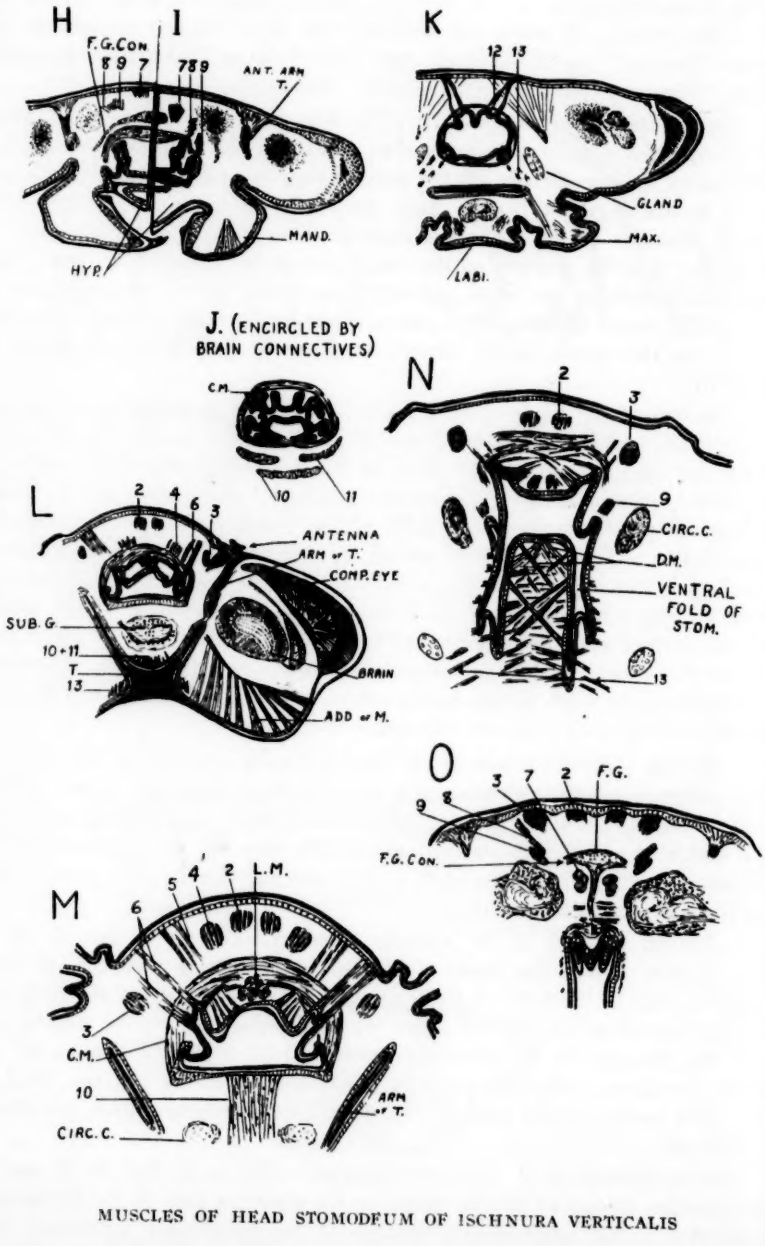
Lateral Dilators of the Pharynx.—No. 8 in figs. C, H, I, and O. This is an elusive pair of slender oblique muscles, consisting of about five strands of parallel fibres, arising dorsally on the parietal areas of the cranium, lateral and posterior to the origin of No. 3. It is shown dotted in, in fig. G. indicating that it is posterior to the structures shown. This muscle passes obliquely in front of No. 9, to be inserted on the outer part of the dorsal fold, just under the anterior margin of the brain, and slightly posterior to the section shown in fig. I (=first lateral dilators of the pharynx, Snodgrass, 1928, p. 117). It might be noted that the second lateral dilators described by Snodgrass, are absent in *I. verticalis*.

Levators of the Floor of the Buccal Cavity.—No. 9 in figs. C, I, H, and O. A pair of slender muscles, composed of parallel fibres, arising on the frons, posterior and slightly medial to the origin of No. 3, passing downward, and somewhat inward, just in front of the circum-esophageal connectives of the brain, to be inserted on the latero-ventral folds of the buccal cavity, just between the circular sheaths of the buccal cavity and of the pharynx. This muscle appears to be homologous with the "Retractores angulorum oris" of Snodgrass, 1935, and the "Retractors of the mouth angles" of Walker, 1931. The position of the muscle is very similar, although the suspensorial bars of the hypopharynx, of which they speak, are not clearly evident in the sectioned heads of *I. verticalis*. However, the hypopharyngeal floor of the buccal cavity is heavily chitinized in this area, as are the ventral horns to which the muscle is attached.

Median Ventral Dilator of the Buccal Cavity.—No. 10 in fig. M. A median, unpaired muscle, consisting of a wide flat band of parallel fibres, arising from the anterior edge of the body of the tentorium, fig. I., and inserted anteriorly on the ventral surface of the buccal cavity. See also fig. A (=ventral dilator of the buccal cavity, Snodgrass, 1928, p. 117, and probably = first ventral dilator of the pharynx, Walker, 1931).

Ventral Dilators of the Anterior Pharynx.—No. 11 in figs. A ,B, C, and J. A pair of thin flat bands of parallel fibres, arising with No. 10 from the anterior edge of the body of the tentorium, fig. I., and passing obliquely forward and upward, to be inserted lateral to the median line, on the ventral surface of the pharynx at its anterior extremity (=first ventral dilators of the pharynx, Snodgrass, 1928, and =second ventral dilators of the pharynx, Walker, 1931). The second ventral dilators of the pharynx, Snodgrass, 1928, are absent in *I. verticalis*.

Dorsal Dilators of the Posterior Pharynx.—No. 12 in figs. K, B, and C. Paired muscles, arising as slender stalks, on the posterior part of the epicranium, just anterior to the antero-medial margin of the mandibular adductor. The fibres spread out fan-wise in an obliquely inward and downward direction, to



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be inserted in about five paired strands on the double dorsal folds of the posterior pharynx (=dilatores postpharyngeales, Snodgrass, 1935, and third dorsal dilators of the pharynx, Walker, 1931).

Ventral Dilators of the Posterior Pharynx.—No. 13 in figs. K, B, C. D, L, and N. A pair of oblique muscles consisting of seven or eight pairs of more or less parallel fibres, arising near the base of the posterior ventral arms of the tentorium, (Fig. L.) and inserted on the double ventral folds of the posterior pharynx, spaced between the circular constrictors of the pharynx (=third ventral dilators of the pharynx, Snodgrass, 1928).

SUMMARY

The muscular sheath, and the dilator muscles of the head stomodeum of a damselfly nymph are here described, from the study of serial sections. This constitutes one more step toward the completion of the literature on the anatomy of the Odonata.

PLATE 6.

Figures A to C are sagittal sections, (i.e. longitudinal sections in the vertical plane) of the heads of *I. verticalis* nymphs in the ultimate instar.

Fig. A is but slightly lateral to the median line. The stomodeum is somewhat contracted, especially the posterior pharynx, (compare fig. J.).

Fig. B is lateral to A, but from a different specimen, in which the stomodeum is expanded.

Fig. C is lateral to B. This specimen apparently had the buccal cavity expanded, and the pharynx contracted, when killed in warm fixative.

Fig. D is still more lateral.

Figs. E, F, and G. represent transversa sections of the head. Fig. E is the most anterior, and the others are successively more posterior, — at irregular intervals.

PLATE 7.

Figures H to K are transverse sections of the head.

Fig. H, I, is a composite, of which H is slightly anterior to I. Fig. H is in the plane of the frontal ganglion connectives.

In fig. J, only the stomodeum and muscles are shown, and they are in the plane where the stomodeum passes thru between the circumesophageal connectives of the brain. The stomodeum is here strongly contracted.

Fig. K is posterior to the brain, and from a specimen with the stomodeum expanded.

Figs. L to O are frontal sections, i.e., longitudinal sections in the horizontal plane. Fig. L is the most ventral, and each of the succeeding ones, more dorsal.

Fig. L is about the same magnification as the preceeding figs., but M, N, and O are enlarged much more.

Due to the bend in the stomodeum, (compare fig. A), figs. L and M show cross sections of it, while fig. N. cuts through the head *at* the bend of the stomodeum, and shows the ventral folds of the posterior pharynx in longitudinal section. Fig. O shows a longtudinal section of the pharynx.

ABBREVATIONS

Ant. Ph.—Anterior pharynx. B. C.—Buccal cavity. Cib.—Cibarium. Circ. G.—Circumesophageal connectives. C. M.—Circular muscle. D. M.—Diagonal muscle. Esoph.—Esophagus. F. G.—Frontal ganglion. Gland.—Salivary gland. Hyp.—Hypopharynx. Labi.—Labium. Labr.—Labrum. L. O.—Lateral ocellus. L. M.—Longitudinal muscle. Mand.—Mandible. Max.—Maxilla. M. O.—Median ocellus. P. Ph.—Posterior pharynx. T.—Tentorium. Sub. G.—Subesophageal ganglion. Sup. G.—Supraesophageal ganglion.
1—Compressors of the Labrum. 2—Anterior or Dorsal Retractors of the Labrum. 3—Posterior or Vetral Retactors of the Labrum. 4—Dorsal Dilators of the Cibarium. 5—First Dorsal Dilators of the Buccal Cavity. 6—Second Dorsal Dilators of the Buccal Cavity. 7—Dorsal Dilators of the Anterior Pharynx. 8—Lateral Dilators of the Pharynx. 9—Levators of the Floor of the Buccal Cavity. 10—Median Ventral Dilator of the Buccal Cavity. 11—Ventral Dilators of the Anterior Pharynx. 12—Dorsal Dilators of the Posterior Pharynx. 13—Ventral Dilators of the Posterior Pharynx.

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NOTES ON SOME TROPICAL NOCTUIDS IN NORTH AMERICA.

BY A. GLENN RICHARDS, JR.,
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The following notes are written to place on record certain authentic records of tropical species taken in the southern United States. Most of these species are not at present recorded in the North American lists. Unless otherwise stated all specimens are in the author's collection.

ACRONYCTINAE

Antaplaga dela Druce. 2 ♂ ♂, Alpine, Texas. Oct. 4, 1930. (G. P. Engelhardt, Collector).

Determined from Hampson, Cat. Lepid. Phal., vol. 9, pp. 384, 386. 1910. Checked to original description (Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 361. 1894) and to figure of type (Biol Centr.-Amer., Het., pl. 94, fig. 29.).

Chalcopasta acema Druce. 1 ♀, Santa Rita Mtns., Arizona, July 26, 1926.

Determined from Hampson, Cat. Lepid. Phal., vol. 9, p. 222, 1910, and from comparison with figure of type (Biol. Centr.-Amer., Het., pl. 30, fig. 14). Checked at the U. S.National Museum by the late F. H. Benjamin. Mr. Benjamin informed me (*in litt.*) that there is a specimen of this species in the Nation Museum from the Huachuca Mtns., Arizona.

PLUSIINAE

Mouralia tinctoides Guenée. 1 ♂, Florida City, Florida.

June 11, 1933. (Mrs. L. E. Forsyth, Collector). An unmistakable species. Determined from Hampson, Cat. Lepid. Phal., vol. 13, pp. 591-592, 1913. The late Mr. F. H. Benjamin informed me (*in litt.*) that the National Museum has a specimen of this species from Victoria, Texas.

EREBINAE

Melipotis contorta Guenée. 1 ♂, Indian River, Florida (Hy. Edwards collection at Amer. Mus. Nat. Hist.). 1 ♂, "Florida" (Slosson collection at Amer. Mus. Nat. Hist.). 1 ♂, 1 ♀, Biscayne Bay, Florida. (Slosson collection at Amer. Mus. Nat. Hist.).

Determined by comparison with specimens from Puerto Rico determined by Dr. Wm. Schaus.

Melipotis januaris Guenée. ♂ ♂, ♀ ♀, Florida City, Florida, May 22, 1933 and July 20, 1934 (Mrs. L. E. Forsyth). ♂ ♂, ♀ ♀, Miami, Florida. June 22, 1934, July 9, 1934, July 15, 1934, July 18, 1934 (Mrs. L. E. Forsyth). 2 ♀ ♀, Biscayne Bay, Florida (Slosson collection at Amer. Mus. Nat. Hist.). 1 ♂, Charlotte Harbor, Florida (Slosson collection at Amer. Mus. Nat. Hist.).

Determined by comparison with specimens from Puerto Rico determined by Dr. Wm. Schaus. Determination of specimens from Miami and Florida City checked at the U. S. National Museum by the late Mr. F. H. Benjamin. Dr. F. M. Jones informs me (*in litt.*) that he collected this species at Royal Palm State

Park, Florida (determined by Dyar and Benjamin).

Melipotis cellaris Guenée. This is the species that passed on American lists for years as "*Panula inconstans* Gn." (see Holland, Moth Book, pl. 30, fig. 21, 1903). *P. inconstans* Gn. is another tropical species, to date not recorded from North America. This correction is now generally known. Specimens of *M. cellaris* Gn. are in the author's collection from Texas and Arkansas.

Melipotis prolata Walker. 1 ♂, 1 ♀, Dry Tortugas, Florida (Collection of Amer. Mus. Nat. Hist.). 1 ♂, Marco, Florida, April 17, 1922 (Collection of Amer. Mus. Nat. Hist.). 2 ♀ ♀, Charlotte Harbor, Florida (Slosson collection at Amer. Mus. Nat. Hist.). 1 ♂, 3 ♀ ♀, "Florida" (Slosson collection at Amer. Mus. Nat. Hist.). 1 ♂, "Florida" (Hy. Edwards collection at Amer. Mus. Nat. Hist.).

Determined by comparison with specimens in the U. S. National Museum by the author.

Melipotis perpendicularis Guenée. 1 ♂, "Texas" (Hy. Edwards collection at Amer. Mus. Nat. Hist.).

I would not include this species on the above record but for being informed by Dr. F. M. Jones (*in litt.*) that he captured this species at Royal Palm State Park, Florida (determined by Dr. Dyar and subsequently by Mr. Benjamin).

Boryzops purissima Dyar. 1 ♂, Florida City, Florida (collected by and in collection of Mr. J. G. Franclemont).

Determined from figure in Hampson, Cat. Lepid. Phal., vol. 11, pl. 186, fig. 15, 1912, and checked by comparison with type at the U. S. National Museum by Dr. Wm. T. M. Forbes.

Athyrma ganglio Hubner. Many ♂ ♂ and ♀ ♀, Florida City, Florida. June 15, 1934, June 24, 1934, July 3, 1934, July 14, 1934, July 22, 1933 and August 7, 1933. (Mrs. L. E. Forsyth, collector). Determined by comparison with Hubner's figure (Zutr. exot. Schm., figs. 421-422.) and checked at the U. S. National Museum by the late Mr. F. H. Benjamin.

Ephyrodes cacata Guenée. 1 ♂, 1 ♀, Florida City, Florida. Sept. 11, 1933. (Mrs. L. E. Forsyth, collector). Determined by comparison with specimens from Puerto Rico determined by Dr. Wm. Schaus, and checked at the U. S. National Museum by the late Mr. F. H. Benjamin. (This species has already been recorded from Texas and Florida by Barnes & Benjamin, Proc. Ent. Soc. Wash., vol. 28, p. 21, 1926.)

Anomis impasta Guenée (=*doctorium* Dyar) 2 ♂ ♂, 5 ♀ ♀, Florida City, Florida. May 5, 1934, May 13, 1934, July 3, 1934 and August 5, 1934. (Mrs. L. E. Forsyth, collector). Determination and placement of *doctorium* Dyar as synonym by the late Mr. F. H. Benjamin at the U. S. National Museum.

DESCRIPTIONS OF EASTERN NORTH AMERICAN SPECIES OF BAETINE MAYFLIES WITH PARTICULAR REFERENCE TO THE NYMPHAL STAGES.

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During the course of investigation of the mayfly fauna in streams in Ontario and Quebec it became apparent that many of the nymphs of the Baetinae are not known although the adults of most have been named. A few nymphs

are described in scattered papers in the literature and a key has been made for some *Baetis* and *Pseudocloeon* (McDunnough 1932, 1932a) which satisfactorily separates groups within these genera. It would seem that in work on streams in the future these small mayflies would become increasingly important because of their abundance and wide distribution. For this reason descriptions are offered below and drawings of what it is felt are useful characters with a view to aiding in the identification of these forms. The list is by no means complete so that identification should be made with caution. The descriptions are made after the examination, in most cases, of a great many individuals but the description itself and the figure is of a typical individual. There is considerable variation in most species so that the descriptions and figures should not be given too much weight but should be used as an aid in identification where large numbers are available showing some range of variation. The collecting of adults at the same locality and at the same time as full grown nymphs are collected will also aid greatly in making determinations.

The associations of nymphs described in this paper with their adults were made, some by rearing in cages set in the streams, others by long familiarity with both adults and nymphs of various bodies of water, and finding adults at the times when the nymphs were known to be full grown and emerging.

Lengths given in descriptions are the distance from the front of the head to the tip of the abdomen excluding the length of the caudal filaments. In the plates the abdomens of all species are drawn to the same scale. The gills and labial palps are drawn to a larger scale than the abdomens but this scale is the same for all species.

The author wishes to acknowledge his indebtedness to Dr. J. H. McDunnough of the Entomological Branch at Ottawa for allowing him to compare his nymphs with those in the National collection, many of which had been reared to the adult condition, thus definitely associating the two stages.

BAETIS

Among the nymphs of Baetis described below several groups are recognizable which appear to stand fairly well separated at the present state of our knowledge but with more collecting in other localities intermediates will probably turn up. There is the *B. vagans* group including *vagans, rusticans* and *pluto*. This group is not very compact and should perhaps be subdivided. *Baetis hudsonicus* described in the present paper should perhaps be included in this group but is probably better left out and considered as a species intermediate between the *vagans* group and *B. brunneicolor*. *Baetis frondalis* is rather distinct from other Baetis but shows the same type of labial palp as that found in *B. brunneicolor*. The *cingulatus* group forms a very compact series including *B. phoebus, B. cingulatus, B. levitans* and *B. flavistriga*. The nymphs of all the species in this group are characterized by banded caudal filaments and similar abdominal maculation. *Baetis intercalaris* would seem to come near this group but to be distinct. The banding of the caudal filaments is of a different type than in the *cingulatus* group there being a dark base to each filament in addition to the dark band and tip. *The pygmaeus* group is represented in this paper by two species, typical *B. pygmaeus* and its northern form and *B. mcdunnoughi* described as new.

Baetis brunneicolor McD. (1925 a)

This is a large species found in the headwaters of streams investigated. It frequents the edge of the stream in the vicinity of rapids where it was obtained by scooping beneath the banks with a dipper.

Nymph Pl. 8., figs. 4, 4a, 4b.

Length:—6.2-7.6 mm. A large dark brown nymph.

Head:—evenly brown with fine median pale line; antennae brownish especially basal segments.

Thorax:—brown with paler brown mid-dorsal line and obscured paler areas near bases of wing pads; legs paler suffused with brown in basal ¾ of femur and distally on tarsus; tarsal claws pectinate.

Abdomen:—obscurely brown dorsally with somewhat paler areas down the mid-dorsal line and laterally in each segment; lateral flanges of segments pale; a pair of dark dots submedially placed about the middle of each segment; venter evenly brown, somewhat paler than dorsum and becoming darker posteriorly; faint submedian ganglionic dots; median caudal filament about 2/3 lateral and all caudal filaments brown in the basal half, pale distally with a dark tip; gills with prominent tracheae and edged medially and laterally with brown.

Pine river, Horning's Mills, Ont., 6-VII-1931. F.P.I.

Baetis hudsonicus n. sp.

Mr. H. E. McClure of the University of Illinois kindly sent the author mayflies collected by him in the vicinity of Churchill, Manitoba. Among others was this large *Baetis* nymph which apparently is undescribed. It is possible that the adult is named but it is doubtful since the adult of this species will be larger than any described North American species. Apparently, judging by the form of the labial palp and other characters, the species comes near *B. brunneicolor*.

Nymph Pl. 10., figs. 11, 11a, 11b.

Length:—7.5-8.5 mm.

Head:—dark brown; antennae brown.

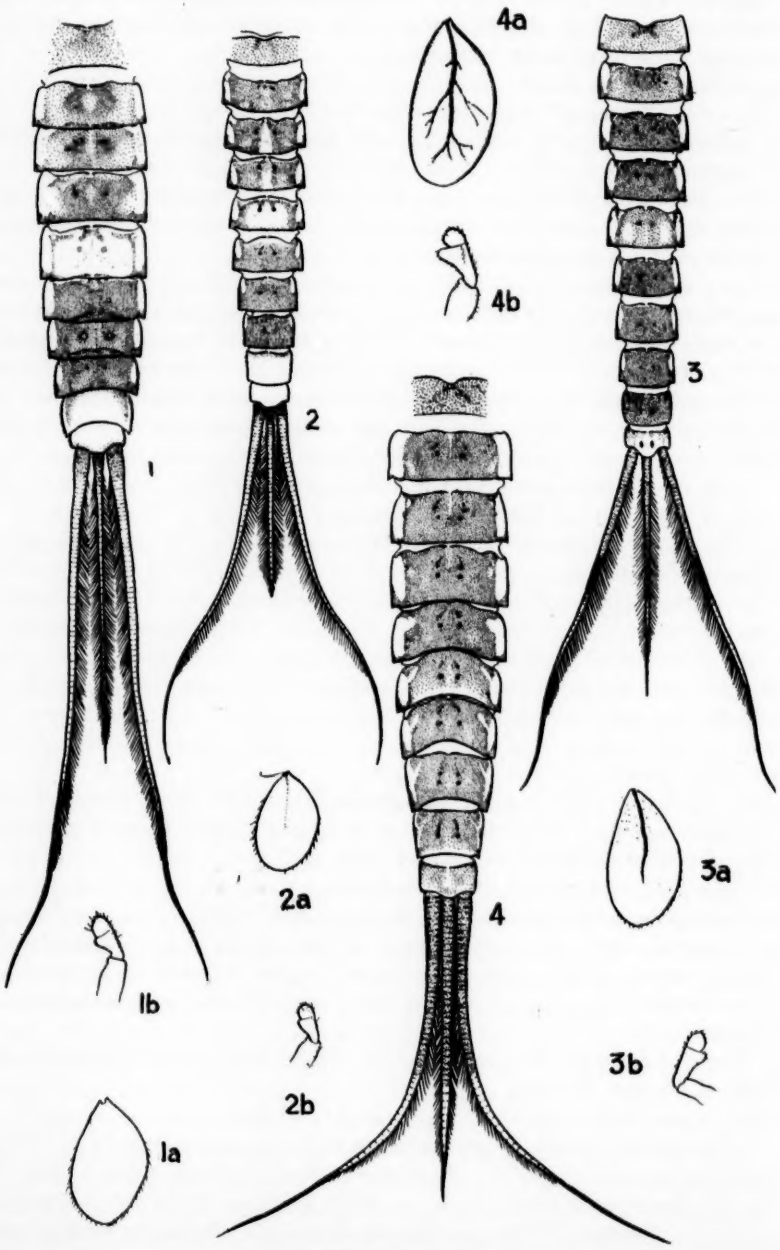
Thorax:—pronotum evenly brown; mesonotum brown with somewhat paler submedian bands and pale areas near bases of wing pads; legs somewhat paler and evenly suffused with brown; tarsal claws pectinate.

Abdomen:—the usual double row of submedian dark dots on a brown background with paler areas suffused with brown; lateral borders of segments pale; venter somewhat paler brown with row of submedian darker dots and anterior border of posterior segments somewhat darker; segment 1 pale; caudal filaments subequal, median rather longer, lacking bars; gills obovate, long, without conspicuous tracheae.

Type:—Churchill, Man., 22-VII-1936. H. E. McClure. In Royal Ontario Museum of Zoology, Toronto.

Baetis vagans McD. (1925)

This species, (which clings to stones,) is common in the rapids of all streams investigated. Typical *vagans* emerges early in the season and is followed later in the season by a smaller form to which the name *B. incertans* McD has been applied. There is evidence to be presented in a later paper dealing with distribution which suggests that *B. incertans* is a generation of small *vagans*. Murphy (1922) has demonstrated three cycles or generations in *B. posticatus*



BAETINE NYMPHS

which Traver (1935) considers to be synonymous with *B. vagans*. Presumably the name *incertans* has been applied to the small mid-summer generation. The present association is based on rearing of adults from nymphs.

Nymph Pl. 8., figs. 1, 1a, 1b.

Length:—6.8 mm.

Head:—four faint brown submedial stripes between compound eyes; brownish suffusion below ocelli and around bases of antennae.

Thorax:—pronotum brown with paler marks posteriorly in form of two curved bands beginning at the middle line about the middle of the segment and extending laterally along posterior border; mesonotum brown with paler brown areas at bases of wing pads and with the posterior extremity pale; wing pads paler than notum; legs pale with dark areas present as a narrow dark bar basally and an incomplete dark bar about the middle of the femur; the joint between femur and tibia, also that between tibia and tarsus and the distal end of the tarsus dark; tarsal claws pectinate.

Abdomen:—in well marked specimens segments 5, 9 and 10 are pale; a double row of dots placed a little anterior to the middle of the segments and submedian in position, these dots dark in segment 5 and pale in the darker segments; in some segments median pale areas near the anterior border of the segments, laterally large suffused pale areas which are in some segments continuous with the pale lateral border of the segment; venter pale on segments 9 and 10, dark brown on segment 8, and brown becoming less dense on the segments anteriorly; caudal filaments without bars but slightly darkened at the base and tip; the median filament about 5/9 the length of the lateral filaments. Gills on segments 1-7 without visible tracheae.

Credit river, Forks of Credit, Ont., 15-V-1934. F. P. I.

Baetis rusticans McD. (1925)

The association of nymph and adult was not made by rearing in this species so that it is with a certain amount of uncertainty that I describe this nymph under this name. Dr. McDunnough has nymphs tentatively referred to *B. rusticans* which agree well with mine. It is a nymph which might easily be confused with those of the small summer generation of *B. vagans*.

Nymph Pl. 8., figs. 2, 2a, 2b.

Very similar to *Baetis vagans;* its smaller size and the fact that the median caudal filament is relatively shorter, being slightly under ½ the length of the lateral filaments, provides a basis for separation; caudal filaments unbanded but slightly darkened at the base and tip; the gills on segments 1-7 without conspicuous tracheae.

Nottawasaga river, Primrose, Ont., 10-VII-1928. F. P. I.

Baetis pluto McD. (1925)

This species occurred in rapids in tributaries of the Ottawa river. The association was establshed by rearing.

Nymph Pl. 8., figs. 3, 3a, 3b.

Length:—4.5-5.3 mm.

Head:—a median pale area, broad on vertex and narrowing on frons, between the compound eyes; a brown triangle between ocelli; antennae pale basally, suffused with brown on flagellum.

Thorax:—brownish with narrow pale median stripe margined by broad pale brown submedian stripes; indefinite pale areas laterally, and a well defined pale area at base of each wing pad; the posterior extremity of mesonotum dark brown and in front of this a median cup-shaped pale area; legs pale, a small dark dot basally in the femur and an indefinite dark band about two thirds of the way out on the femur; tibia and tarsus pale, suffused with brown.

Abdomen:—dorsally uniform brown except for pale area on flange of segments 3, 4, 6, 7, 8 & 9; segment 5 mostly pale as in *B. vagans* with two submedian dark dots and anterior transverse brown band extending posteriorly at the sides (in some individuals segments 8 and 9 paler with suffused brown areas and the two dark dots distinct); segment 10 pale with two dark submedian dots; venter, pale on segment 10, dark brown on segments 8 and 9, this dark brown restricted to median region on segment 7 and passing forward as a small triangle on segment 6 leaving anterior segments pale; caudal filaments with a prominent dark band about the middle, a dark tip and the basal part evenly suffused with pale brown; gills on segments 1-7 with distinct main trachea, gill 1 small.

Masham Mills, P.Q., 29-VI-1935. F. P. I.

The following four species together with others comprise a closely related group of mayflies which are difficult to distinguish from one another especially in the nymphal stage. The adult characters, too, although very definite in typical specimens, tend to break down making identification difficult. *B. phoebus* and *B. cingulatus* are large species, *B. levitans* somewhat smaller and *B. flavistriga* smaller still. There seems to be a real problem in systematic treatment arising in this group. *Baetis cingulatus* appears to have a wide distribution being found in streams of different character e.g. those of limestone and granite country. It appears in most localities early in the season and is followed by another member of the group. In my experience this other member has been a form of *levitans* in limestone streams and *flavistriga* in igneous rock streams.

This suggests that in these species we are perhaps dealing with subspecies or with a single species which varies considerably with the character of the water or possibly with species which have evolved independently from *B. cingulatus* in these different waters. All members of the group have banded caudal filaments.

Baetis phoebus McD. (1923)

The nymph figured and described here was taken from the wave-washed shores of a lake and the adult reared. The species also occurs in large rivers such as the Ottawa. This nymph is, I believe, the one which Clemens (1915) described under the name *B. propinquus* as his description fits these individuals well and his specimens were collected in a similar habitat.

Nymph Pl. 9., figs., 5, 5a, 5b.

Length:—5-7 mm.

Head:—pale with light brown submedian line; antennae pale.

Thorax:—notum pale with darker maculation, consisting of submedial stripes and irregular pale areas; legs pale with dark band about the middle of the femur, basally in the tibia and distally in the tarsus, tarsal claws pectinate.

Abdomen:—the dorsal maculation very similar to that of *Baetis vagans*, with segments 5 and 9 mostly pale; a double row of dark submedian dots and posterolat-

eral to the dark dot a small pale area; caudal filaments pale with a conspicuous dark band about halfway back on each filament and a dark tip; middle filament about 7/9 length of a lateral filament; gills on segments 1-7 without conspicuous tracheae.

Frank's bay, lake Nipissing, Ont., 5-VII-1929. F. P. I.

Baetis cingulatus McD. (1925)

Nymph Pl. 9., figs. 6, 6a, 6b.

Length:—5.3 mm.

Head:—pale with narrow submedian brown line over vertex breaking up into irregular brown blotches on frons; laterad a broader brown submedian band; distance between turbinate eyes of male about equal to width of one turbinate eye.

Thorax:—notum pale with light brown markings similar to those of following species but somewhat paler; legs pale with dark triangular mark at base of femur, another about the middle of the femur and a small one at the apex; tibia dark apically and with faint dark mark basally; tarsal claws pectinate.

Abdomen:—very similar dorsal maculation to that of *B. phoebus* the main difference being the greater extent of the submedian pale areas, giving the nymph a generally paler appearance, but the pale areas are not as extensive as in the next species; two pale dots near middle of segments and anterior to these convergent pale dashes in some individuals, in others these latter obsolescent; segment 10 entirely pale; the caudal filaments with a distinct black bar about the middle and a dark tip; gills without visible tracheae, in some individuals these are present but indistinct.

Credit river, Erindale, Ont., 21-V-1934. F. P. I.

Baetis levitans McD. (1925)

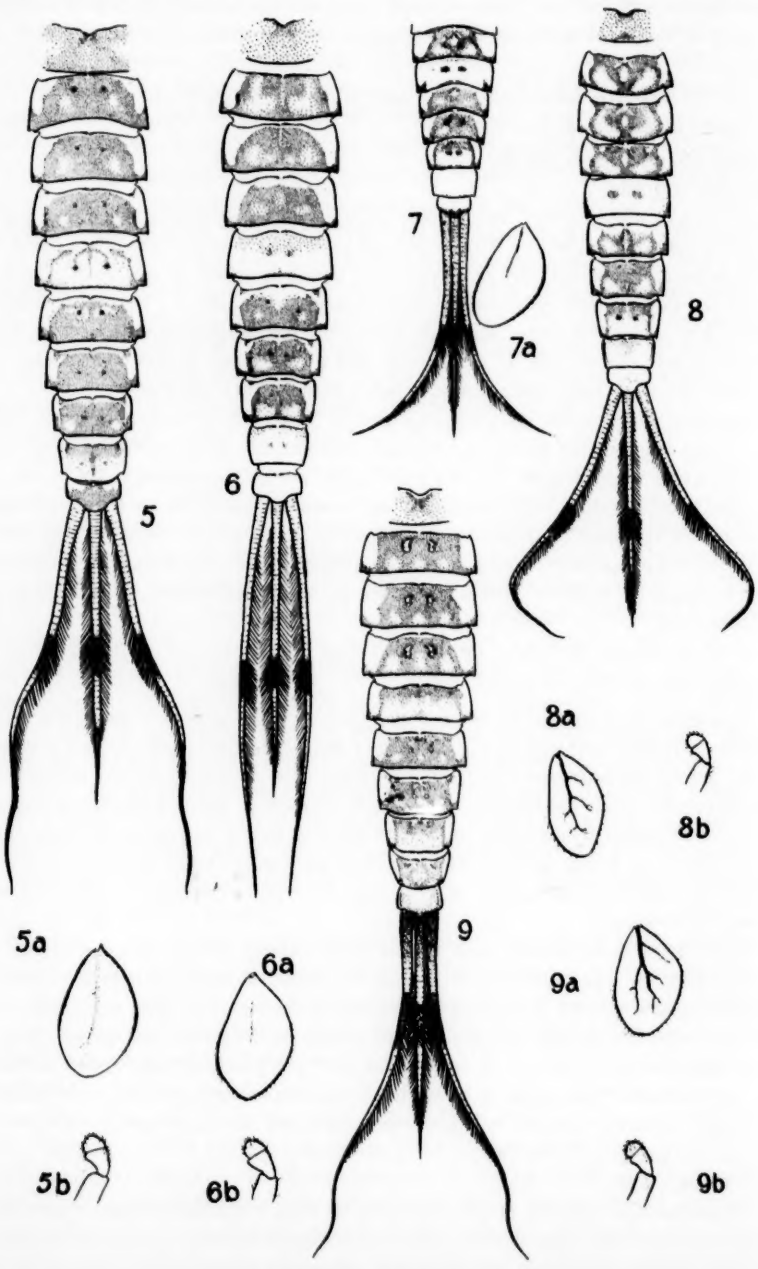
The nymph described here is the form which occurs in the Credit river, Ontario. Typical *levitans* is slightly larger than this form and differs somewhat in the extent of brownish flush on the abdominal segments of the male imago. The brownish flush consists of a posterior transverse band in each of segments two to six extended anteriorly above the pleural region in typical *levitans* but in the Credit river form the brownish flush along the posterior border of the segments and anteriorly above the lateral fold is very indistinct or absent from all but segment five.

In both the Ottawa and Credit rivers there occurs a member of this group which in size agrees with typical *levitans* but lacks almost all traces of brownish markings on the anterior abdominal segments of the male. What is believed to be the nymph of this species is not described in this paper; it is almost identical with that of *B. cingulatus* but somewhat smaller with turbinate eyes of the male about equal in width to the distance between them. The tracheae of the gills are quite distinct in some individuals and inconspicuous in others.

Nymph Pl. 9., figs. 8, 8a, 8b.

Length:—4.1 mm.

Head:—brownish between developing eyes of male with pale irregular patches in a row on either side of mid-line; distance between turbinate eyes of male slightly less than the width of one turbinate eye; antennae slightly darkened at base of flagellum.



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Thorax:—notum pale with brown markings consisting of broad stripes and irregular areas; wing pads paler; legs pale with dark marks, a small triangular patch at base of femur, an incomplete band about middle of femur and patch at apex; slight darkening at base of tibia, distal ends of tibia and tarsus dark; tarsal claws pectinate.

Abdomen:—maculation very similar to that of *Baetis cingulatus* but with the pale areas more clean cut and more extensive than in that species (in some individuals these may be somewhat suffused); segment 5 pale with two dark submedial spots, segments 9 and 10 entirely pale; converging on the anterior border of the segment at the middle line two small pale dashes; caudal filaments pale with a dark bar half way out and a dark tip; gills present on segment 1-7 with conspicuous tracheae which may be somewhat more developed in some individuals than in others.

Frequently the pale markings of the abdomen are varied, a triangle standing on the anterior border of the segment replacing the two convergent dashes and central median pale spot of the individual figured.

Credit river, Erindale, Ont., 15-VI-1934. F. P. I.

Baetis flavistriga McD. (1921, 1923)

Nymph Pl. 9., fig. 7, 7a.

Length:—3.6-3.9 mm.

Head:—distance between turbinate eyes of male about one and one third the width of one turbinate eye; area between eyes pale with submedian vermiculation; labial palp as in *B. levitans*.

Thorax:—brown above with paler areas; legs pale with dark mark at base of femur, a broad nearly complete dark band about the middle of the femur, dark tip; tibia with proximal and distal ends dark and tip of tarsus dark.

Abdomen:—maculation very similar to that of *B. phoebus*, the pale areas suffused with brown so that they are not so extensive as in *B. cingulatus*, or they may be completely obscured in some segments; segment 9 pale and the extremity of segment 10 conspicuously darkened; the pale basal part of the caudal filaments is slightly darkened, the pale distal band seeming by contrast quite white; gills usually with single (sometimes branched) trachea showing, sometimes invisible; medial edge of gills dark.

This nymph is about the same size as that of *B. levitans* as described above but can be separated by the darker base of the caudal filaments, the generally more suffused character of the maculation including the darker extremity to segment ten and the wider separation of the turbinate eyes of the male.

Ottawa river, Ottawa, Ont., 20-VII-1935.

Peche river, Wakefield, P. Q., 18-VI-1935.

Baetis intercalaris McD. (1921, 1923)

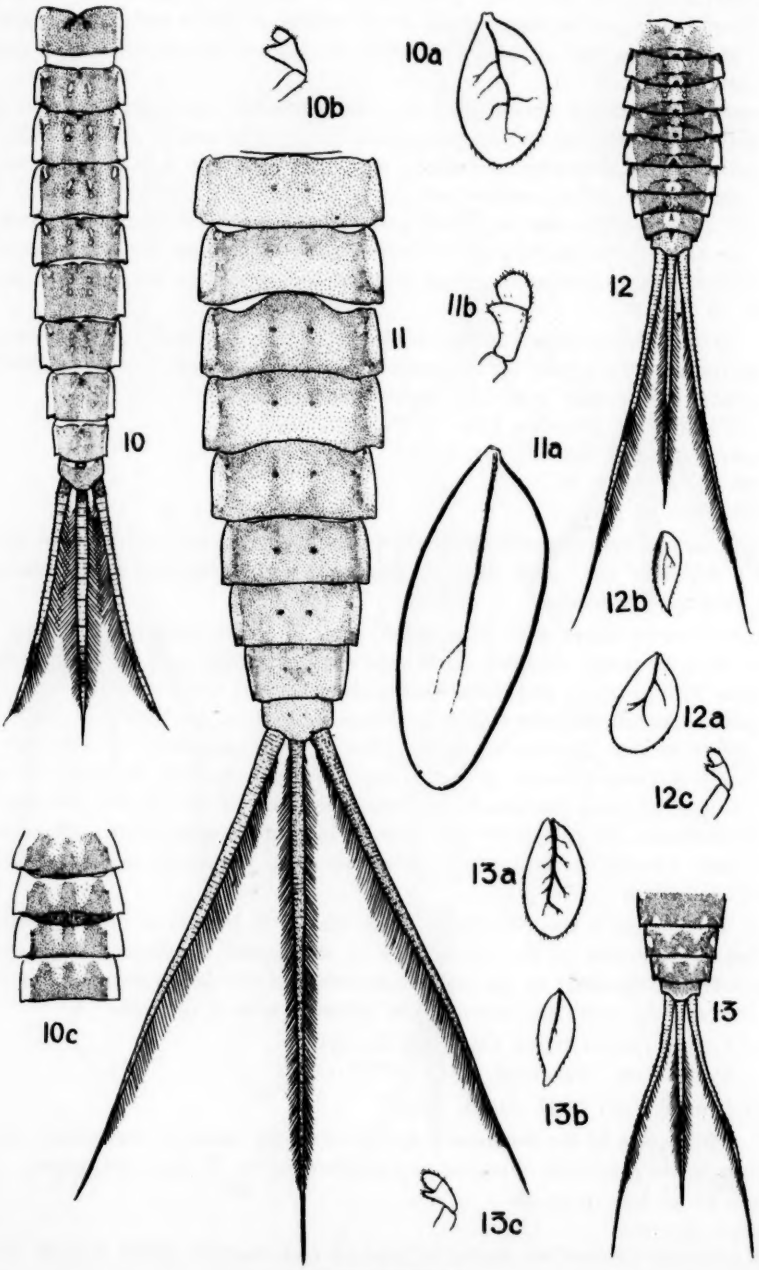
This is one of the commonest species in all the streams investigated where it occurs in company with *B. vagans* and members of the *B. cingulatus* group.

Nymph Pl. 9., figs. 9, 9a, 9b.

Length:—5.0 mm.

Head:—brown vermiculate marks in band to each side of middle line on frons and over vertex.

CAN. ENT. VOL. LXIX. PLATE 10.



BAETINE NYMPHS

Thorax:—dorsum of pronotum with median dark band divided medially by a fine pale line; laterally a pale area, continuous posteriorly with another pale area nearer lateral border; mesonotum with narrow median pale line and two pale lines edged with brown, widely divergent at anterior border and converging on median line about middle of segment; irregular pale and brown areas laterad; in posterior portion a pale mark consisting of a transverse wide band between bases of wing pads with anterior median quadrate projection; legs pale with a dark triangular patch about the middle of the femur, a smaller dark patch basally, and distally in femur and basally and apically in tibia dark shading; tarsal claws pectinate.

Abdomen:—on segments 2, 3, 4, 6, and 7 the pattern is much the same consisting of pale dots and areas on a dark background; near the posterior border are 3 subequal pale areas, one median and 2 submedian; about the middle of each a pair of submedian pale dots and in front of each another pale dot extended anteriorly as a pale stroke converging on the median line (in some specimens and especially in nymphs which are not fully grown the above mentioned dots coalesce, and reach the anterior border of the segment, forming, thus, two anterior pale submedian areas). This arrangement, two anterior pale areas and three posterior pale areas is very characteristic of the species. Segments 5, 8 and 10 mostly pale; caudal filaments with a conspicuous dark band before the middle, and an extensive dark tip; in addition the base is suffused with dark; in well-marked specimens the caudal filaments are usually suffused with dark between the dark base and the dark middle band; gills on segments 1-7 with conspicuous tracheae.

The type of banding in the caudal filament and the three posterior pale areas in the segments separate this nymph readily from nymphs of the *cingulatus* group.

Credit river, Erindale, Ont., 5-VI-1934. F. P. I.

Baetis frondalis McD. (1925 a)

This slender nymph has been found frequenting aquatic vegetation in moderate current in streams. The nymphs were reared to make the association. This species is apparently allied to *B. atrebatinus* of England which occurs in the same type of habitat.

Nymph Pl. 10., figs. 10, 10a, 10b, 10c.

Length:—6.2-7.1 mm. A slender pale brownish nymph.

Head:—a median pale line over head; bases of antennae brown, flagellum paler.

Thorax:—brown with median pale band and small pale areas laterally particularly at the base of wing pads which are themselves somewhat paler in colour than thorax generally; legs pale with incomplete brown bands just beyond middle in femur and basally and distally in tibia.

Abdomen:—in general dorsum rather pale brownish with paler indefinite median line, not always apparent; lateral to this four distinct pale dots, the posterior pair rounded, the anterior pair frequently more elongate and curved or convergent; in the antero-lateral angles and obliquely placed elongate dots, these becoming more extensive anteriorly; venter with posterior 2/3 of segments suffused with brown except for pale lateral flange and 4 pale ganglionic dots in most segments; caudal filaments subequal and stout, the laterals spinulose along lateral border, dark at base and a dark band in the distal third; gills simple lamellae with prominent tracheae.

In some specimens from a different locality the markings are less defined, the pale spots coalescing to form a submedial pale area as shown in pl. 10, fig. 10c.

Male river, McIntyre, Ont., 6-VIII-1930. F. P. I.

Three members of the *B. pygmaeus* group occur in the streams studied. Typical *pygmaeus* nymphs have a pale median dorsal stripe which is apparent also in the imago female. Needham (1909) has described this nymph but a brief description is given below together with a figure. In 1930 the author described another nymph as that of *B. pygmaeus* which is referable to a northern form which for the present it seems advisable to leave with that status. Both these nymphs are characterized by an acutely pointed seventh gill. A third species occurs in the headwaters of various streams in which the seventh gill, although reduced in size and somewhat lanceolate is not acutely pointed. This species appears to be new and a description of the female imago and nymph is given below under the name *Baetis macdunnoughi* n. sp. The members of this group are associated with aquatic vegetation in moderate to slow current although the last mentioned was taken on stones in the rapids also.

Baetis pygmaeus Hagen.

Nymph Pl. 10., figs. 12, 12a, 12b, 12c.

Length:—4.3 mm.

Head:—rather evenly brown; antennae pale.

Thorax:—evenly brown; paler beneath; legs pale with faint darker banding; tarsal claws pectinate.

Abdomen:—reddish brown dorsally with a pale interrupted median stripe; on the middle segments the pale stripe is formed by a number of pale dots, a pair of submedian pale dots posteriorly in the segment and a pair of pale dashes anteriorly converging on a median pale area on the anterior border of the segment; a median dark spot in the angle formed by the converging pale dashes; on the anterior border of the segment near the lateral border a somewhat triangular pale area and the lateral border of the segment itself pale posteriorly; venter pale; caudal filaments long, the median about 4/5 the laterals; a dark bar about half way out on the laterals and a corresponding dark bar on the median; another dark bar about ¾ out on the laterals; gills on segments 1-6 with rounded apices, those on segment 7 with curved and acutely pointed apices, all gills with conspicuous tracheae.

Mad river, Singhampton, Ont., August, 1930. F. P. I.

Baetis macdunnoughi n. sp.

Length:—3.5 mm., wings 3.8 mm.

Female imago

Head:—brown, reddish between ocelli, somewhat paler immediately above and darker between compound eyes; antennae quite dark smoky.

Thorax:—brown, somewhat paler buff on scutellum and anteriorly on mesonotum; pleura paler; venter dark brown; legs smoky amber; mesothoracic wings with no intercalaries between subcosta and succeeding longitudinal vein; metathoracic wings much as in *B. pygmaeus* but with more prominent costal projection.

Abdomen:—dorsum brown, somewhat paler in indistinct median band and on posterior segments; venter pale smoky with small indistinct purplish triangles in antero-lateral corners below pleural fold; caudal filaments smoky.

Nymph Pl. 10, figs. 13, 13a, 13b, 13c.

Length:—4.45 mm.

Head:—brown with narrow pale median line and submedian pale vermiculate spots.

Thorax:—dorsally brown, with halberd-shaped pale area anteriorly in mesonotum, other obscurer pale areas laterally; longitudinal veins of wings traced in brown and between these pale lines towards the periphery of the wing; ventrally, pale; legs pale with incomplete dark bands proximally in femur, beyond the middle in femur, about the middle of the tibia and basally in the tarsus; joint between femur and tibia dark; tarsal claws pectinate.

Abdomen:—dorsum brown, segments 8-10 paler with maculation as shown in fig. 13; segments 1-7 with less pale marking; all segments with a trace of submedian spots and dashes similar to those of *B. pygmaeus;* in addition 3 pale areas along posterior border of segments (sometimes obsolescent) and flanges pale in antero-lateral and postero-lateral angles; venter paler than dorsum but with diffuse darker areas medially in the anterior half of the anterior segments and dark longitudinal strokes near the lateral border setting off the paler flanges; gills on segments 1-6 with rounded apices, those on segment 7 with a bluntly pointed extremity readily distinguishing this nymph from that of *B. pygmaeus;* all gills with conspicuous tracheae.

Holotype—Imago female—Masham Mills, P. Q., 24-VI-1935. F. P. I. in Royal Ontario Museum.

Paratypes—Eight females, same locality, 24-VI-1935—18-VII-1935. F. P. I. in Royal Ontario Museum and National Collection at Ottawa.

Female imagos of typical *B. pygmaeus* have a more prominent mid-dorsal pale stripe and rarely show any purplish shading below the pleural fold on the venter; the venter is in addition paler whitish. Females of the northern form of *B. pygmaeus* lack the mid-dorsal pale stripe but frequently segment 5 is pale above. The purplish shading is present on the venter below the pleural fold and is more intense and contrasts more with the paler venter than in the new species. The two can be most readily distinguished by the fact that the new species is somewhat larger and also by the better development of the metathoracic wing and its costal projection. In females of the northern form of *B. pygmaeus* the hind wing is usually small, varying considerably in different specimens, and shows very little of the costal projection.

(To be continued)

RESEARCH NOTES

OUTBREAK OF ARMYWORMS (CIRPHIS UNIPUNCTA HAW.) IN SAGUENAY COUNTY, QUEBEC.

A conspicuous outbreak of armyworms was observed by the writer in the summer of 1937, along the north shore of the Gulf of St. Lawrence, from Baie Johan Beetz (lat. 50° 18' N., long. 62° 49' W.) to La Tabatière (lat. 50° 50' N., long. 58° 58' W.), a distance of about 190 miles. This is a part of Saguenay County, Quebec, and is essentially a non-agricultural region. The residents depend chiefly on fishing and trapping for earning their living, but often maintain small gardens. Their communities are generally small and are situated close to the shore. They are separated from one another by many miles of land in primeval condition, gererally muskeg, scrub forest, and bare rock. The shore

line is generally rocky, but in some places is sandy, with growths of *Elymus arenarius* L., var. *villosus* E. Mey., *Ammophila breviligulata* Fernald and other plants of maritime beaches.

One place of exceptional character for this region is the Agricultural Illustration Station maintained by the Dominion Department of Agriculture at Cross River, on the mainland near the village of Harrington Harbour. Here, a short distance back from a sandy shore, are eight acres of cultivated fields, with gardens in addition. There is no village at Cross River, and the residence of the superintendent of the Station is situated, with farm outbuildings, at a little distance from the fields. This year the crops at the Station included two acres of oats and two acres of mixed oats and buckwheat. All this was intended to be mowed for hay. Along the upper beach near the Station is a heavy growth of *Elymus* and beach peas, usually used for hay and for pasture.

I first noticed the outbreak of armyworms on August 5, 1937, when the superintendent of Cross River Illustration Station called my attention to a heavy infestation of these larvae then present there, both among the oats in the fields and among the *Elymus* along the beach. Much of the latter plant was eaten down close to the ground. The oat fields looked well from a distance, but on close approach armyworms could be seen on most of the stalks, from which the leaves were being rapidly stripped. The infestation was heavier in the pure stand of oats than in the adjoining stand of mixed oats and buckwheat. To save as much as possible, both grain fields were mowed promptly.

At this time the infestation of these larvae was still inconspicuous in most of the villages where it flared up a few days later. The maximum of conspicuousness of the outbreak was reached at Cross River about August 5, at La Tabatière about August 9 and at Harrington Harbour about August 15. On August 18 the outbreak at Harrington Harbour had diminished markedly in conspicuousness. At all communities visited after August 18, the visible activity and eating by the armyworms had practically ended.

The armyworms appeared to feed chiefly on the foliage and tender parts of various grasses (Gramineae). At one or two places it appeared that they had also eaten common groundsel (*Senecio vulgaris* L.). In many areas in and about the villages their destruction of grass foliage was almost complete. On warm days great numbers of these larvae appeared on rock outcrops (which are common) and on beaten paths, where they ran about as though in a great hurry. There was no organization or co-ordination in their movements from place to place; each individual went its own way. So many larvae were unavoidably crushed under foot on the paths that these became thickly spotted with their bodies, which, in warm sunshine, soon gave off an unpleasant odor. As a result, apparently, of an instinct to seek shelter in crevices, the larvae commonly invaded houses and were found almost everywhere in some dwellings and even in people's clothing.

The small passerine birds of the region assembled in flocks to feed on these larvae. Among species that appeard to be active in this way were the following: *Otocoris alpestris alpestris* (Linnaeus), Northern Horned Lark; *Turdus migratorius migratorius* Linnaeus, Eastern Robin; *Anthus spinoletta rubescens* (Turnstall), American Pipit; various Wood Warblers (Compsothlypidae),

especially *Dendroica striata* (Forster), the Black-pool Warbler; *Passerculus sandwichensis* (subsp.?) (Gmelin), Savannah Sparrow; *Zonotrichia leucophrys leucophrys* (Forster), White-crowned Sparrow, *Passerella iliaca iliaca* (Merrem), Eastern Fox Sparrow.

It is probable that Ruddy Turnstones, *Arenaria interpres morinella* (Linnaeus), which, during the height of the armyworm outbreak at Harrington Harbour, were observed to leave their usual feeding-grounds along the shore to forage on grassy slopes, were also eating these larvae.

At Cross River, where the resident human population is restricted to one family, Herring Gulls, *Larus argentatus smithsonianus* Coues, are reported by the superintendent to have fed heavily on the armyworms and to have been, in his opinion, an important factor in subduing the outbreak. According to his report, a flock of these Gulls, numbering about 100 at its maximum, fed on the armyworms at Cross River for about a week. They first attacked the larvae among *Elymus* on the upper beach, close to the usual feeding-ground of these birds, but later invaded the oat-fields, nearly half a mile from the sea. Local residents were inclined in several instances to attribute the general disappearance of the larva in the villages to the attacks of the flocks of passerine birds, but I suppose that that general disappearance was due chiefly to a movement of the larvae, at the proper stage in their life-history, into their hiding places. Although the heavy destruction of armyworms by passerine birds may have been insufficient to constitute a factor of prime importance in controlling the outbreak, it is conceivable that sustained mass attacks by birds as large as Herring Gulls may, on the other hand, have been locally significant.

Specimens of the larvae collected at Harrington Harbour on August 18, 1937, and submitted to the Entomological Branch of the Dominion Department of Agriculture were identified as *Cirphis unipuncta* Haw.

HARRISON F. LEWIS.

Dominion Parks Branch.

NEWS AND VIEWS.

STRONG SUGGESTS INSECT EXTERMINATORS GO AFTER PESTS ON THE FARM

Commercial insect pest control operations, now directed almost exclusively to household insect pests, might well be extended into other fields of insect pest control, according to Lee A. Strong, Chief of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. This industry would benefit also from a licensing system for its operators, which would stop present unfair competition for legitimate firms with fly-by-night concerns using unscientific methods and also end the serious health and property hazard from the use of dangerous chemicals by inexperienced people.

Speaking before the 5th Annual Convention of the National Pest Control Association at Memphis, yesterday (October 26), Mr. Strong suggested these changes in the rapidly expanding insect extermination industry and outlined the interdependence of the Bureau of Entomology and Plant Quarantine and that industry.

The Bureau's research, he said, is the base for all control measures. Commercial operators alone can put the results of much of this research to practical use. Special equipment and special technic are required for using many of the measures developed by the Bureau. "When pest control operators efficiently carry out their work," Mr. Strong said, "they demonstrate in the most effective way possible the value of the research by the Bureau and other related institutions."

MR. ERLE G. BREWER NAMED HEAD OF JAPANESE BEETLE CONTROL AND DUTCH ELM DISEASE ERADICATION PROGRAM IN THE UNITED STATES.

Mr. Erle G. Brewer succeeds Mr. Leon Howard Worthley, who died on October 9th at Montclair, N. J., as leader of two of the U. S. Department of Agriculture's most extensive insect control campaigns (eradication of Dutch elm disease and Japanese beetle control).

Since 1906 Mr. Brewer has been associated almost continuously with the work of the division he now heads. Several years ago he was active in gypsy and brown-tail moth control work in New England. When the Department increased its emphasis on the control and prevention of spread of the European corn borer, he was transferred to that work. Later he was assigned to Japanese beetle control. The division of which Mr. Brewer is in charge covers Japanese beetle control, Dutch elm disease eradication, and inspection and certification of products to meet the requirements of Federal and State quarantines on account of the European corn borer and gypsy and brown-tail moths.

Mailed Saturday, November 6th, 1937.